



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/018,727	08/09/2002	Colin Robert Willis	41577/266144	5079

7590 12/15/2009
John S Pratt
Kilpatrick Stockton
Suite 2800
1100 Peachtree Street
Atlanta, GA 30309-4530

EXAMINER

PADGETT, MARIANNE L

ART UNIT	PAPER NUMBER
----------	--------------

1792

MAIL DATE	DELIVERY MODE
-----------	---------------

12/15/2009

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/018,727	Applicant(s) WILLIS ET AL.	
	Examiner MARIANNE L. PADGETT	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 November 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 28-43 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 28-43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>11/11/9</u> . | 6) <input type="checkbox"/> Other: _____ |

Art Unit: 1792

1. A **Request for Continued Examination** under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/11/2009 has been entered.

Applicants have canceled all previously examined claims (& withdrawn claims), and presented a new set of claims having 4 independent claims, all of which contain the limitations of previous independent claim 1, as it was presented in the amendment of 2/13/2009, plus requiring that the deposited reactive epoxy-containing coating be continuous, with independent claim 28 being the broadest & independent claims 32, 34 & 36 being combined with various new limitations also present in new dependent claims.

2. **Claims 28-43** are rejected under 35 U.S.C. **112, second** paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The new claim requirement of **claims 29, 33, 34 & 36** recites "the pulsed plasma discharge is applied in a **single** ON-OFF sequence" (emphasis added), however this terminology is **ambiguous** in that it could mean that the pulsed plasma discharge is applied by turning ON a single time and OFF a single time, or it could mean that some sequence of plasma pulses is applied, with the implication that no more sequences are applied, however other sequences are not positively excluded, nor is what constitutes a sequence limited (note applicants' citation of page 6, lines 18-20 gives an example using different phrasing, & which is not a definition). Given the uncertain meaning of this new limitation, which cannot be clearly interpreted in light of the specification, the intended scope of this claim limitation must be considered unclear, i.e. vague and indefinite. Note that given the possible meaning of employing a single pulse of plasma, it is unclear how one would determine the average power density, since once the plasma

Art Unit: 1792

is OFF after a single pulse, it is OFF for all time, hence it is unclear if any OFF time would even be considered in calculating such an average. A single on-off sequence may also describe a continuous plasma, thus it may be considered uncertain how short the ON time must be to be considered a pulse.

Claims 40 & 41, which depend from independent claim 36, require "**the reactive surface epoxide groups** of the polymer coating" to have reacted "after exposure of **the** functionalized substrate" (emphasis added) to individual conditions of these 2 claims, however the limitations of these dependent claims lack proper antecedent basis due to use of inconsistent terminology, since the independent claim requires the presence of "reactive epoxy groups", and while "epoxy" & "epoxide" are synonyms, applicants' claim language has formally differentiated these terms, such that while the limitations of the dependent claims could refer to the epoxy groups of the independent claim due to the overlapping meaning of their nomenclature, but they can not necessarily be said to do so. However, the article employed implies that they were intended to be the same, thus the phrasing lacks clarity. Similarly, the phrasing "the functionalized substrate" was not employed in independent claim 36 & while the results of the independent claim process could be called a functionalized substrate, this limitation cannot be said to necessarily refer to the results of claim 36, further contributing to the lack of clarity of these claims.

In **claim 42**, its preamble on lines 1-3, referred to actions of independent claim 28 reciting "... **a surface** comprising applying a reactive epoxy containing coating to **the surface**..."(emphasis added), such that "the surface" could refer to "a surface" of line 1 of this claim, or could refer to "a surface" in line 4 of claim 28, where these two different introductions of undifferentiated terms may or may not be the same, thus creating confusion as to exactly what surface(s) is(are) being referred to. This problem is compounded in line 3 of claim 42, which again refers to "the surface", making it unclear **when** the "contacting the surface with a solution... reacts with the epoxy groups" is intended or necessarily occurs. Since both the coating & the solution containing the nucleophilic reagent are applied to & contacting what could be considered to be required to be the same surface, this claim could be considered to be requiring

Art Unit: 1792

the reagent solution & the glycidyl methacrylate to be being applied simultaneously, thus both are deposited in the presence of the plasma, however the requirement of the nucleophilic reagent reacting with the epoxy groups contained in the coating implies that some other timing might have been intended. However, the claim is silent with respect to temporal limitations, thus this claim's process sequence, it's scope & that of its dependent claim 34 are unclear as written.

3. **Claims 29-43** are rejected under 35 U.S.C. **112**, **first** paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Applicants have cited page 11, lines 27-28, which explains the XPS analysis of the coating of example 1 as showing **no** Si(2p) peak, where the examiner notes the specification indicates this peak would be a signal from the underlying glass substrate showing through, thus the examiner will agree that this is an indication of a continuous coating has been deposited on the example's glass substrate, however only for example 1, which applies pulsed plasma polymerization for 15 minutes to deposit the film (example 1 does not give pulsing details for the pulsed plasma, however the examiner will agree that it is reasonable to consider the taught most preferred average power density discussed on page 6, lines 10-12), thus the examiner finds that this single example provides no evidence that, for example, a 30 second pulsed plasma would necessarily produce a continuous reactive epoxy-containing coating on the substrate, especially on a substrate of unknown material, employing unknown amounts or deposition conditions of glycidyl methacrylate, etc., hence the time limitations as present in new **claims 30, 31, 32, 35 & 36**, clearly encompass **New Matter**.

With respect to the new claim requirement of **claims 29, 33, 34 & 36** reciting "the pulsed plasma discharge is applied in a **single** ON-OFF sequence" (emphasis added), while possible interpretations may encompass parameters as recited on page 6, lines 4-20, especially 18-20, as noted above in section 2, the

Art Unit: 1792

meaning of this phrasing is ambiguous, and the examiner finds no evidence supporting the most literal meaning of turning the plasma discharge on & off once, thus these claim limitations also may be considered to encompass **New Matter**, especially considering the claim of particular time periods with respect to such a sequence, particularly as combined with average power density.

With respect to new **claims 37, 38 & 39**, which require "the plasma discharge is **OFF** for a period of **at least 10000 μ s** between each pulsed discharge" (emphasis added), the examiner found no support for this claimed range, with or without the limitations from which these dependent claims depend. Applicant's cited support of page 5 lines 6-8 has absolutely nothing to do with pulse off time, being directed to glycidyl methacrylate, while cited page 6, lines 12-19, really must include line 20, which recites "a typical sequence is one in which the power is on for 20 μ s and **off for from 10000 μ s to 20000 μ s**" (emphasis added (also see original claim 7)), thus the specification provides no support for unlimited lengths of OFF times is presently claimed, nor does this teaching support the limitation with the maximum of 20,000 μ s, since this range is only taught when used in conjunction with a 20 microsecond ON time, thus these new limitations clearly encompass a great deal of **New Matter**.

In new **claims 40 & 41**, the beginning of example 2, on page 13, lines 15-22, provided teachings where the epoxide functionalized surfaces of glass slides of **example 1** were subsequently reacted to trifluoroacetic acid vapor for 30 minutes in a space that was subsequently evacuated, or were **immersed** in a solution of an amine (diethylamine or ethylenediamine) for 24 hours, then rinsed in pure methanol. Thus while the vapor example has little information concerning the conditions during vapor exposure, the claims "exposure...to a solution...for 24 hours" (claim 41) is significantly broader in scope than the taught "immersed into a solution...", as exposure encompasses a great many means of exposure to solution, i.e. a mist of the solution, a thin solution layer deposited thereon, etc., thus **claim 41** as written encompasses **New Matter** with respect to the exposure limitation. The results of the exposures of claims 41 or 40, require specific percentages of reactions with the surface epoxide groups, which assuming that they are

Art Unit: 1792

the same as independent claim 36's reactive epoxy groups, a single example which uses a coating made by plasma polymerization of glycidyl methacrylate monomer vapor (example 1, page 11), does not provide support for the claimed reaction percentages on all possible coatings deposited by independent claim 36, since the process recited therein encompasses coatings made in times much shorter than those of example 1, as well as coatings made by depositing glycidyl methacrylate containing layers (e.g. solutions) on a generic substrate surface, then thereafter applying a pulsed plasma discharge to the already deposited layer, since the independent claims as written only require "the presence of glycidyl methacrylate", which encompasses both monomer vapor as described in example 1, or glycidyl methacrylate deposited as a liquid on the substrate surface before pulsed plasma treatment, which alternative is not supported by the original specification, for these post-plasma derivation treatments, thus encompasses **New Matter**.

Note that as original claim 1 had the "in the presence of..." limitations with respect to the formula that encompasses the presently specifically claimed glycidyl methacrylate, as does original disclosure on page 3, the possibility that the glycidyl methacrylate may not be a vapor monomer by itself is not new matter, however the only clear specific example of how the pulsed plasma polymerization process was performed employs glycidyl methacrylate monomer vapor (example 1, page 11), thus claimed processes that rely on this example for support, where the claims are not limited to the pulsed plasma polymerization being performed with monomer vapor encompass **New Matter**, which is all the new independent **claims 28, 32, 34 & 36**, as they rely on data from example 1 to support the continuous coating aspect of the new claims.

Claims 42-43, due to their lack of clarity as discussed above in section 2, may be said to encompass **New Matter**, as the phrasing as written in these claims encompasses simultaneous applying the coating containing reactive epoxy & contacting with a solution of nucleophilic reagent, however the

Art Unit: 1792

original specification cannot be said to support the possible meanings encompassed by the current claimed language.

4. The following is a quotation of 35 U.S.C. **103(a)** which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. **Claims 28- 39 & 42-43** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Connell et al** (UK 1,037,144), in view of **Timmons et al** (5,876,753) or visa versa, previously discussed in sections 9-10, 5, 3, 3 & 4 of the actions mailed 1/12/2005, 9/28/2005, 3/21/2006, 8/28/2006 & 5/17/2007, respectively.

Applicants' new claims require depositions to be continuous coatings, however as neither of these references are requiring patterned deposition, nor suggesting limiting the area on which plasma polymerization occurs, while they are not discussing "continuous" coatings nor "discontinuous" coatings, it would've been obvious to one of ordinary skill in the art that blanket plasma treatment of substrate surfaces is being performed that the results of the plasma polymerization processes may reasonably be considered to produce continuous coatings. In Timmons et al., no discussion on col. 12, lines 20-67+,

Art Unit: 1792

which may certainly be considered to be consistent with & inclusive of polymer coatings having reactive functional groups on their surfaces, a where the polymer coatings are considered continuous.

Applicants have added new limitations that may include using a single plasma pulse (i.e. "a single ON-OFF sequence") or which may be no different than normally is considered to be intended by saying pulsed plasma discharge, in the latter case is irrelevant to previously applied rejections, being inclusive of any ON-OFF sequence of pulses, even those having varying pulsed links or varying duty cycles or any combination thereof, as long as one may arbitrarily call it a sequence. Applicants have additionally added limitations for the pulsed plasma discharge to be from 30 seconds-20 minutes (or 2-15 minutes), plus have added a limitation where the plasma discharge time may be 10,000 μ s (10 ms) to infinity. Since as previously discussed **Connell et al.**, who specifically shows plasma polymerization of vaporized monomers of glycidyl methacrylate, is not using a pulsed plasma & **Timmons et al.**, who does discussed the desirability of employing pulsed plasmas in order to retain reactive functional groups when performing plasma polymerization, does not use the specific monomer of applicants, the significance of the newly claimed parameters must be considered in view of the combination thereof, thus with respect to routine experimentation when employing the specific glycidyl methacrylate monomer vapor as suggested by Connell et al., using a pulsed plasma polymerization process as suggested by Timmons et al. for retaining functional groups inclusive of epoxy groups.

Length of time one performs any deposition process, inclusive of pulsed plasma depositions employing the claimed glycidyl methacrylate, will depend on many factors, such as desired thickness (unspecified by claims or specification), flow rate of deposition source (unspecified by claims, one example in specification, not relevant to claims), pressure (unspecified by claims), etc., where such parameters will affect the deposition rates (unspecified by claims or specification), such that the currently claimed times cannot be said to have any patentable significance due to significant lack of context, where furthermore it would've been obvious to one of ordinary skill in the art, to consider such known

Art Unit: 1792

parameters, desired thickness & the like, and determined by routine experimentation the length of time required to effect a desired thickness of coating having reactive functional groups which are known to be desired as taught by Timmons et al., which would reasonably have been expected to include times as claimed.

With respect to claimed OFF times, which are broader than supported by the original disclosure, the originally disclosed limitations were previously discussed, thus relevant discussion with respect to routine experimentation may be found below.

As previously discussed, Applicants' independent claims require glycidyl methacrylate (GMA), instead of the broader polymerizable epoxy monomer of the previously claimed formula II of which GMA was a specific species, however the obviousness of using this particular species was previously considered & discussed as set forth below. Independent claim 1 has also requires the pulsed plasma deposition conditions, where average power density of $\leq 0.0025 \text{ W/cm}^3$, which is the only pulsed plasma deposition condition required, and the only deposition requirements are that polymer growth occurs, such that epoxy groups are present in the coating in some unspecified amount.

As previously discussed, in **Connell et al**, see Fig. 1, p. 2, lines 26-53 & 87-128+ for plasma apparatus and parameters used in the plasma polymerization process, and see p. 2, lines 66-72 for a variety of monomers that includes epoxies, such as **glycidyl methacrylate** (line 70), which according to applicants' specification (p. 5, lines 6-8, which gives this compound as an example of applicants' formula III), and is now the specifically claimed compound in the independent claim. From the structure of glycidyl acrylate (p. 569 of Hawley's Cond. Chem. Dictionary, 12th ed), it was previously noted that the analogous methacrylate compound corresponds to applicant's formula (II), where $R_1 = \text{CH}_3\text{C}=\text{CH}_2$; $n = 1$, for the CH_2 group.

While Connell et al teach plasma polymerization of claimed GMA monomers, they do not discuss use of pulsed plasma and parameters associated therewith, or reactive potential of resultant epoxy

Art Unit: 1792

functionalized coated surface with a nucleophile, such as an amine or carboxylic acid as in dependent claims 12 & 21.

Timmons et al teach plasma polymerization of monomers using continuous or pulsed plasma, where use of low energy plasma, as exemplified by a pulsed plasma of 200 W (over what volume is not given, but maybe assumed to always be the same volume & applicants hypothesize effective volume is 943 cm^3 {page 9 of 11/11/09 response}) and on-off duty cycles of 3/5, 3/15, 3/45 and 3/60 ms, using allyl bromide to illustrate important principles of Timmons et al's process ((col. 6, lines 26-45 & Ex. 1 on col. 14), i.e. these *exemplary* conditions can not and should not be considered limiting to all the possible types of monomers that the reference suggest as useful) that a sharp increase in a bromine functional group content was seen in the film as the duty cycle during deposition was decreased, i.e. a 400% increase in bromine functional group content relative to carbon atoms at the 3/60 ms duty cycle (with applicant's hypothesis 0.01 W/cm^3) compared to continuous (CW) plasma results. However Timmons specifically suggest when discussing parameters generally, including power applied, that the nature of specific monomer will also affect the plasma variables employed (col. 7, lines 15-56, especially 30-37), as may be further exemplified by their various examples, such as example 5, where retention of the acid chloride group ($-\text{COCl}$) is desired, where again increased retention of the desired functional group was observed with decreased power during deposition, where striking retention was disclosed for average power below 5 W & particularly below 1 W (§ bridging col. 16-17), e.g. assuming applicants' hypothesize effective volume ($1\text{ W}/943\text{ cm}^3 = 0.001\text{ W/cm}^3$ & $5\text{ W}/943\text{ cm}^3 = 0.005\text{ W/cm}^3$), which may given applicants own analysis, be reasonably considered to suggest the usefulness of average power densities as claimed for oxygen-containing functional groups, especially considering that teachings of Timmons et al. specifically suggest that the nature of each monomer would reasonably require routine experimentation, thus it would have been reasonable for one of ordinary skill in the art to consider exemplary parameters for functional groups with similar heteroatoms, recognizing that the less stable the functional groups would reasonably

Art Unit: 1792

have been expected to require employing lower average power densities. {With respect to the calculation of the volume of Timmons et al.'s plasma reactor provided by applicants, based on references supplied with the 11/11/2009 IDS, while the suppositions made by applicants may be considered reasonable, one cannot say definitively that the 943cm³ volume was necessarily the volume of the plasma reactor used in the examples in Timmons et al., but it does provide a reasonable suggestion of considering use of claimed average power densities for oxygen containing functional groups.}

However, the present claims no longer require specific ON/OFF times, having no limit for ON times, with a range of OFF times starting at 10,000 μ s, extending to infinity. It was previously noted that average powers for exemplary duty cycles for plasma polymerization using allyl bromide would be approximately 75W, 33W, 12.5W & 9.5W, respectively, but are for total power input, not power density, thus cannot be directly compared to the claimed parameter range, or applicant's tests, but would have been expected to show the same general trend as power density, which expectation remains consistent considering above comments with respect to hypothesize effective volume applied to values given in Timmons et al..

In Timmons et al., it is further taught to **use of such low energies to enable the deposited polymer to retain active functional groups** that can be **employed in a derivation reaction to covalently couple to these groups**, which are taught to **include** various **O-containing functionalization, including epoxy (table on col. 9)**. The derivatization is said to be a variety of nucleophilic displacement, which may use various **amino** containing materials that are a subset of the claimed amines. See the abstract; col. 3, lines 45-col. 4, line 38, esp. col. 3, lines 50-55 & 62-col. 4, lines 5, 24 & 30-38; col. 6, lines 15-col. 7, line 45+; col. 8, line 1-6; col. 9, lines 1-32. It would have been further obvious to one of ordinary skill in the art when employing the pulsed plasma process, to determine desirable ranges of pulsed plasma parameters for the polymerization reaction of specific compounds in a specific pulsed plasma apparatus via routine experimentation to provide an effectively low power plasma, as taught by

Art Unit: 1792

Timmons et al, to enable retention of reactive functional groups, especially given their teaching on col. 7-8, that **different reaction chambers** provide additional **variables for determining parameters**, and employing taught power, on/off relationships or exemplary trends as a guide to power (& corresponding power density) and cycle time determination. It was noted that applicant specification does not actually disclosing the any explicit duty cycle ranges per se , but instead only a single specific ON time (20 μ s) & a range OFF times (broadened without support in the present claims), other than comparison to constant plasma generation, the specification does not provide any particular significance to either the specific examples or general ranges of ON/OFF time from which some possible duty cycles may be calculated, nor to the duty cycle in general, **considering determination of “pulsing arrangements” to be “routine” (page 6, lines 17-18)**, hence no unexpected or critical results was seen to be taught in association with these on/off times or duty cycle values, especially considering the general concept is covered by Timmons et al., including in comparison to constant plasma generation.

While Timmons et al include epoxy-containing monomers in their teachings, exemplified by allyl glycidylether; they do not disclosure applicants' particularly claimed GMA monomers. Also the particular claimed energy density range (or disclosed exemplary on-off time) parameters are not explicitly taught.

It would have been obvious to one of ordinary skill in the art to employ the pulsed plasma process in the deposition of Connell et al or the monomer, glycidyl methacrylate, in the process of Timmons et al, because in the first case, Timmons teaches the equivalent usage of continuous or pulsed for plasma deposition (abstract), but further provides advantages in energy control due to use of pulsed plasma, that generally enables retention of reactive functional groups & further use of the deposits for the claimed process of immobilizing a nucleophilic reagent without further modification, thus suggesting the desirability of pulsed plasmas & motivating their use instead of continuous plasmas, when retention of reactive functional groups, such as epoxy, is desired. Use of Connell et al's monomer in Timmons et al's

Art Unit: 1792

process, would have been obvious, as it is consistent with the generic categories of useful compounds taught, capable of providing desired functional groups for the subsequent derivatization/immobilization reaction, and has been shown to be effectively deposited via plasma polymerization, which is the process employed by Timmons et al, thus providing motivation to employ the particular monomer source of GMA for epoxy functional groups.

It would have been further obvious to one ordinary skill to determine desirable ranges of pulsed plasma parameters for the polymerization reaction for specific monomers via **routine experimentation** to provide an effective low power plasma as taught by Timmons et al, especially given their teaching on col. 7-8, that different reaction chambers provide additional variables for determining parameters, and employing taught power, on/off relationships & exemplary trends as a guide to power usage (hence power density) and related cycle time determination, depended on the particular monomer to be polymerized & functional group to be retained. Note while Timmons et al provides some exemplary powers, they do not give power **density**, which can not be specifically determined or explicitly compared, if plasma volume is not known, but energy density is related to the above routine experimentation to determine parameters, hence would have been expected to be considered by one of ordinary skill and competence in the art.

Independent claims presently require "an average power density of the pulsed plasma discharge is less than 0.0025 W/cm^3 " (previously narrowed from less than 0.05 W/cm^3), & the claimed power density remains germane to the routine experimentation arguments. Hence, it remains considered that while the applied references do not provide values of power density *per se*, Timmons et al. was previously noted to provide **teachings on routine experimentation** to provide **an effective low power plasma** in col. 7-8. Particularly see therein lines 28-45 in col. 7, which discuss how the volume of the reactor chamber affects power density in plasmas of like power, stating "**large reaction volume** at a given applied power would also **provide increase retention of monomer functional groups**, as this variation in effect **decreases the power density** during plasma polymerization processes" (emphasis added), thus from the teachings of

Art Unit: 1792

Timmons et al., it is considered that it would have remained clear to one of ordinary skill in the art to employ routine experimentation to adjust one's power density for the particular reagents employed, so as to provide desired retention of monomer functional groups as taught, which from the teachings of Timmons to effect low-power plasmas, that take into consideration volume & therefore power density, would have been expected to include optimization to relatively low powers, such as those within average power densities claimed, particularly for especially reactive functional groups like epoxy. The narrower claimed power density range was & is not considered to provide a significant differentiation from teachings of routine experimentation for essentially optimization purposes, especially as one of ordinary skill would realize that optimization values would vary depending on the particular functional group desired to be retained, with the general knowledge that epoxies are generally very reactive (i.e. easily reacted), so would have been expected to require lower energies than less reactive functional groups, & further considering that **applicants' specification** provides no determinable actual evidence or data for the superiority of the presently claimed average power density range, with or without combination with ON/OFF times over any other average power density range or cycle times used in another pulsed plasma (i.e. different plasma generating frequencies &/or pressures &/or temperatures, etc.), that can be **necessarily** derived from the specification as originally filed.

Applicants have previously alleged (bottom p.7, 12/30/2005 remarks) that Timmons et al. teach away from "low pulsed plasma discharge", however this "low" had no definitive meaning & their following discussion concerning pulsed low duty cycles is only indirectly relevant to the claims, as the previous unsupported duty cycle ranges were deleted from the claims, plus the current claims no longer even require any limitations to the timing of the pulses (only some off times). Applicants' previous discussion (top p.8, 12/30/2005 remarks) of depositions using "pulses of extremely low mean power (0.04 W)" with reference to Exs. 4 & 5 on p. 9, was noted to be inconsistent with the **applicant's specification's** examples, as none of the examples on p. 9-10, i.e. Exs. 1-9, have any teachings of "mean

Art Unit: 1792

power", as they all provide only a "peak power = 40W", which even given the ON and OFF times of the plasma, does not provide sufficient information to calculate an arithmetic mean power, as **peak power** is the **highest value** reached, providing no other information on what percentage of the ON time is at peak power or instantaneous power values during the ON period, nor would such a value have any relevant meaning with respect to the present claim limitations, which relate to power density, thus require one to know the plasma volume. The examiner noted that $< 0.05\text{W/cc}$ & the preferred range of $< 0.0025\text{W/cc}$ was introduced on p. 6, lines 10-12, where the "average power of the pulsed plasma discharge" would in context more properly read --average power density...--, however the context of the specification would imply that this is the average power over the duration of the pulses only, because that's when the discharge is taking place, but discussion concerning duty cycle, which was Relevant to know canceled claim 7, suggest averaging over both the pulses ON-time and OFF-time. As the examiner noted no teachings of plasma volume for the particular taught ranges of $(20\mu\text{s ON})/(10,000\text{-}20,000\mu\text{s OFF})$, she found no way to relate the claimed plasma power density values to the exemplary 40W peak power used with the exemplary ON/OFF times $(20\mu\text{s}/20\text{ms})$, hence the examples are not commensurate in scope with the claim limitations.

With respect to specification teachings relating to criticality of the pulsed plasma parameter of power density (i.e. $< (0.05 \text{ or } 0.0025) \text{ W/cc}$), the only place it was found to be mentioned was on p. 6, lines 10-12, where average power density was never particularly related specifically to any of the individual compounds, nor more than generally to the on-off times (i.e. duty cycle). None of the examples disclose what power densities were used to produce their results, only providing teachings comparing continuous wave plasma and pulsed plasma, where the pulsed plasma used specific parameters of a peak power of 40 W, with $20 \mu\text{s}$ ON time/ 20 ms OFF time, which as discussed above provides no determinable significance to the power density in the independent claim 1. While the compositional data on the deposits comparing continuous plasma and pulsed pulsed, show significant differences

Art Unit: 1792

therebetween, those differences are consistent with & expected from the teachings of Timmons et al., who notes that as compared to continuous plasmas, pulsed plasmas are expected to increase retention of functional groups, such that one would have expected that an increased percentage of heteroatoms a functional groups, such as oxygen or increased percentage of the functional group itself, to remain. Thus applicants' experimental data (specification & declaration, see above discussion) is consistent with the expectations provided by the teachings of Timmons et al. for pulsed plasma versus continuous plasma, especially **lacking a clear showing** that this particular range of **power densities** has a **significantly** different or unexpected effect or trend in the deposition of GMA, as compared to higher power densities also for pulsed plasmas (i.e. not just the expected trends & effects suggested by the teachings of Timmons et al.), or that GMA as compared to other epoxy monomers is significantly differently effected {e.g., such as producing different trends for the scope of the claimed process for GMA & comparison for AGE, but specification Exs. 1 & 4 are not commensurate in scope with the claims (see above concerning parameters) and insufficient data is present to determine any unexpected differences}, hence the examiner finds no patentable significance in this particular single parameter range for the claims as written, as it appears to be consistent with routine experimentation to optimize pulsed plasma parameters; expected taught trends associated with pulsed low-power plasmas; and lacking in generalized significance to the scope of all possible pulsed plasmas.

As was **previously noted** with respect to applicants' 6/30/2008 arguments concerning Timmons et al. & Connell et al., it appeared that applicants believed that each reference must be virtually a 102 in order to be combinable, however the demonstration of the equivalence of two epoxy compounds for plasma polymerization need not rely on both references having the same exact enduse {or presupposed that two different epoxy compounds would have the same optimized deposition parameters}, in order to provide a reasonable expectation that plasma deposition processes would have analogous results & that advantages of a particular variety of plasma processing, in this case pulsed plasma processing, which is

Art Unit: 1792

taught to have an advantageous effect generically for functional groups on plasma polymerized monomers, would have reasonably been expected given the evidence of equivalent use in plasma polymerization depositions, to behave analogously. Applicants' previous apparent suggestion that in order to combine Connell et al. with Timmons et al., Timmons must disclose GMA (p. 5 of 6/30/08 response), simply makes no sense, since there would be no reason to combine Connell et al. to supply a teaching Timmons et al. already had. Applicants appeared to apply the same illogic to the rejections that combine Timmons et al. with Kolluri et al. or Chabreck et al. (p. 8 of the 6/30/08 response). Applicants' discussion on ps. 6-7 of their 6/30/2008 response continued to rely on unclaimed parameters & discussion that is not commensurate in scope with claimed requirements. The examiner found that a particular calculation for average power as cited by applicants at the top of col. 8 in Timmons et al., is no way inconsistent with the claim of average power density by applicants, since while not the same, average power & average power density are related {divide average power by plasma volume = average power density}, thus the teachings in no way negates the need or expected usefulness of routine experimentation for a particular monomer & apparatus. The examiner agreed with applicants' statement "...that straightforward extrapolation from the Timmons plasma polarization conditions to the presently claimed powers does **not** necessarily lead to **unexpected** results" (emphasis added, p. 7 of 6/30/08 response), but cannot agree that no unexpected results demonstrate any novelty or unobviousness.

Applicants' **previous** arguments (6/30/2008) concerning deposition using GMA versus AGE, by which the examiner presumes they were referring to their specification's figures 2 & 8 from examples 1 & 4, respectively, as has been previously pointed out to applicants, does not provide data which is commensurate in scope with the claims, hence provides no clear evidence with respect to the patentability of claimed limitations. That 2 different epoxy monomers provide different IR spectra when treated in the like pulsed plasma peak power & on/off times (methodology of the example 1 said to be used in example 4, thus presumably like temperatures, pressures, frequencies etc. were used, although not restated), gives

Art Unit: 1792

only a single data point, which as previously pointed out by the examiner cannot be clearly related to the claimed limitations due to the lack of correspondents between claimed power densities & information provided concerning the experimental parameters. Furthermore, as these two epoxy monomers **have different overall chemical structure**, one of ordinary skill & competence in the art would expect different optimization for their use in pulsed plasma deposition due to expected different activation energies, etc., required for reaction, when one wants, as was shown to be known & desirable in the prior art, to retain the epoxy functional group, thus this single comparison under energy conditions that cannot be properly compared to those claimed (or even if they were commensurate), as a single data point cannot show relevance to the metes and bounds of the claimed average power density parameter range for all possible pulsed plasmas.

6. **Claims 28-39 & 41-43** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Timmons et al** ((753), discussed above in section 5), in view of **Kolluri et al** (5,723,219), previously discussed in sections (10 & 12-13), (3 & 5), 5 & 6 of the actions mailed 1/12/05, 3/21/2006, 8/28/2006 & 5/17/2007, respectively, and reiterated below.

As noted above **Timmons et al** teach allyl glycidyl ether (AGE) as an **exemplary epoxy-** containing monomer, instead of the claimed epoxy compound of GMA, but **Kolluri et al** also teach analogous plasma polymerization reactions, where either **AGE or GMA** are taught to be **deposited for their reactive epoxy functional groups**, hence use of GMA in Timmons et al would have been expected to be effective for the taught process due to taught equivalent usage, providing an alternative species for the generically taught epoxy containing monomers. Above discussions of routine experimentation are equally applicable in this combination, as previously noted, including expected need to optimize for each individual monomer that contain like functional groups desired to be retained.

In **Kolluri et al.**, specifically see the abstract; col. 2, lines 35-57+ for prior art plasma polymerization and its limits; col. 3, lines 5-26 for background discussion of **pulsed plasma**

Art Unit: 1792

polymerization to preserve functional groups in deposited films; summary for sequential plasma depositions; col. 5, lines 40-49 for classes of monomer including **epoxies**, with lines 47-48 teach allyl glycidyl ether, **glycidyl methacrylate** (GMA), etc; col. 6, lines 5-30 teaching various amines & lines 60-67 plasma in general to plasma deposit monomeric compounds as sources of named functional groups; col. 7, **table I** gives surface functional groups, where the functional group remaining on the surface for 1st plasma deposited layer is in the first col. of table I, and what it reacts with in the 2nd col., with what's produced in the last col., where #13 and 14 give specific examples that react amines functional groups with epoxy functional groups on the surface (i.e. epoxy group reacting with alkylamines or dialkylamine generically, as well as ROH); col. 8, line 62-col. 9, line 14, esp. 3 and 10-11 with such suggested combinations; cols. 9-15+ with specific examples noting plasma may be pulsed (col. 9, line 50; col. 10 line 52; col. 12, line 56-57, etc); col. 16, line 30-60; & col. 20, line 18-col. 21, line 23 discussing and illustrating first plasma deposition using GMA, then plasma depositing an amine thereon via reaction with the epoxy group; and claims 1, 4-6, etc.

Kolluri et al. teach epoxy functional groups as one of a possible first group of functional groups to be deposited by plasma polymerization, generally teaching a second vapor deposition via plasma to attach second functional groups reacted to the first functional group, where the second functional group includes carboxy, carboxylic ester, hydroxy, etc., where taught monomer sources for carboxylic acid functional groups include acetic acid (claims & col. 6, lines 31-40), however Kolluri et al. does not specify trifluoro acetic acid, nor particularly reacting epoxy & carboxylic acid groups. Kolluri et al. also teach a wide variety of monomer sources for amines functional groups, inclusive of various primary amines & other alkylamines, e.g. ethylene amine, ethylene diamine, etc. (col. 6, line 5-30), but does not discuss solution chemistry for depositing/reacting with the secondary functional group.

Applicants have **previously** objected to Kolluri et al. because the epoxy group is only one example of various functional groups that may be plasma deposited, however suggesting alternative

Art Unit: 1792

functional groups in no way negates the teachings of the usefulness or the effectiveness of plasma polymerization to achieve epoxy functionalized coatings. Additionally note, while Kolluri et al. do not explicitly teach that pulsed plasma is used with the deposition of GMA monomer, they do explicitly teach that the plasma depositions produce coatings that retain functional groups, which in the case of GMA is epoxy group (col. 16); they do generally teach that pulsed plasmas may be used; & explicitly state on col. 3, lines 9-25 that "pulsed plasma has been employed with variable duty cycle to preserve the functional groups of films during deposition using plasma polymerization... It is **known** that the **power applied**, the **frequency of the pulse**, and the **duty cycle** can be **varied to preserve the functional nature** of the deposited film..." (emphasis added). Thus, while pulsed plasma may not be explicitly mentioned as used with the specific monomer GMA, the suggestions & advantages of employing pulsed plasma deposition in Kolluri et al. would clearly suggest to one of ordinary skill & competence in the art the advantages thereof, especially as combined with Timmons et al., who further elaborates on the advantages of pulsed plasma for functional group retention and parameters generally important therefore. Note that Kolluri et al. differs from the independent claims by not suggesting specific average power densities for their suggested pulsed plasmas, thus also not suggesting average power densities for the specifically taught GMA monomers, but like Timmons et al., they have teachings that suggest routine experimentation is expected for determining appropriate parameters for preservation of the functional nature of the deposited film, so these references are consistent with each other & continue to be considered as suggesting to one of ordinary skill in the art that the use of pulsed plasma, plus the choice of power density for preservation of a particular functional nature for a particular monomer would have been expected to be a matter of routine experimentation, lacking any clear evidence to the contrary.

As **previously discussed** with respect to Applicants' 6/30/2008 argument (page 8) that a single exemplary use of pulsed plasma in step 2 of Ex. 1 at 100 W power & pulsed at 10 Hz with a 10% duty cycle (no plasma volume given, thus no power density can be necessarily determined, but it's a 4.0 liter

Art Unit: 1792

plasma reaction chamber, so average power density could be a minimum of about $(100 \text{ W} \times .10)/4.0 \text{ L} = 0.0025 \text{ W/cm}^3$) using acrylic acid monomer, somehow determines all pulsed power usage as taught by Kolluri et al., fails to provide any convincing arguments therefore (or why a single power usage, with power density unknown, should be considered a necessary difference from power density of the claims, particularly considering the 4.0 L plasma chamber), especially considering this example is for plasma polymerization of acrylic acid optimized to retain acid functional sites, where applicants have provided no rationale why one of ordinary skill in the art would necessarily apply an optimization for acrylic acid to the alternative options using epoxies (probably more reactive), such as examples using GMA as found on col. 16 (formula 19, lines 30-45) or col. 20 (lines 30-55), when col. 3 as previously pointed out, so clearly suggests optimization dependent on the nature of the functional group being deposited and maintained. It would be reasonable to consider the acrylic acid parameters as a rough starting point for routine experimentation, given both have oxygen functionalities & no other specific examples that are closer, however one would not consider simply the exemplary power applied without consideration of the volume over which it is applied, nor the expected difference in reactivity of the functional group to be retained, as was done by in applicants' arguments.

7. **Claims 28-39 & 42-43** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Timmons et al** ((753), discussed above in section 5), in view of **Chabreck et al.** (WO 98/28026), previously discussed in section 9 of the action mailed 5/17/2007.

Chabreck et al. provide teachings concerning plasma polymerization mechanisms for unsaturated (i.e. vinyl groups, p.9) monomers carrying reactive groups, such as epoxies, where it is desired to retain the reactive groups or functionalities on the plasma polymerized coating, where the last paragraph on p.4 teaches that epoxy groups are particularly susceptible to plasma decomposition. Chabreck et al. teach that controlling & retaining the functional groups on deposits of the plasma polymerized unsaturated monomers with reactive groups, such as GMA (p.33, Ex.B-5), is effected by use

Art Unit: 1792

of the afterglow of the plasma, which is mechanistically equivalent to the off-time in a pulsed plasma process. Additionally, when discussing useful plasma parameters, Chabreck et al. teach that the plasma is preferably "an inductively coupled, pulsed radio frequency glow discharge plasma" (page 11, especially last two lines). Chabreck et al. further teach that their primary plasma polymerized coatings with reactive groups, such as epoxies, **may be further reacted**, such as with solutions where the compositions have groups reacted with the retained reactive group of the polymerized coating. Examples C-14 & C-15 on page 38 employ the plasma polymerized coating of GMA to **react with solutions** of "4-amino-Tempo" or "Jaffamine ED2001", which appear to be tradenames for **amine-containing** compounds. Example C-14 is particularly of interest for employing an alcohol based solvent (isopropanol/water 4:1) in which the plasma modified at substrates were soaked for extended periods of time. In Chabreck et al., further see the abstract; 1st paragraph, p.1; p. 3-6, especially the paragraph bridging p. 5-6+ following paragraph; p. 7, 3rd full paragraph, noting suggested amine-containing molecules for the top or secondary coating, such as aminoalkanes like methylamine ; p.12, especially paragraph bridging p.12-13; paragraph bridging p. 16-17 through p. 19, especially top & middle paragraphs p.17.

Given the above teachings of Chabreck et al. on the need to protect functional groups like epoxies on monomers, such as GMA, from the decomposition effects of plasma in order to provide plasma polymerized epoxy functionalized coatings to be used for further reaction was secondary coating solutions that may contain amines, it would have been obvious to one of ordinary skill in the art to employ unsaturated epoxy containing monomers, such as GMA, in the pulsed plasma process of Timmons et al. as discussed above, as Chabreck et al. indicate that GMA requires protection from the decomposition effects of an *in situ* continuous plasma in order to provide plasma polymerized depositions that retained the epoxy functional group, while simultaneously indicating that pulsed plasmas that employ the afterglow from the plasma discharge will both enable such retention of epoxy functionalities in the deposited coating and effectively polymerized the GMA, hence the examiner takes

Art Unit: 1792

notice that one of ordinary skill in the art would recognize the correspondence with the pulsed plasma teachings of Timmons et al., which recognize the superior retention of functional groups in general when using pulsed plasmas versus continuous plasmas, as well as the resultant coatings usefulness for reacting with secondary coatings, such as amines, and thus apply the above discussed teachings of routine experimentation in Timmons et al. to determine effective pulsed plasma parameters for GMA used in Timmons particular pulsed plasma polymerization deposition technique, as Chabreck et al. provides motivation therefore by explicitly suggesting that analogous treatment is necessary with GMA monomers for functional group retention.

Applicants' 3/30/2008 arguments with respect to Chabreck et al., failed to address the reasons for obviousness presented by the examiner, as their arguments appeared to equate a remote plasma as having the same effect as an *in situ* continuous plasma, which is contrary to the teachings of Chabreck et al., & with which one of ordinary skill in the art would not agree, since no plasma is being actively produced at the deposition site, so that when depositing, the conditions are more analogous to the off-time during a pulsed plasma, than the on-time.

8. **Claim 41** is rejected under 35 U.S.C. **103(a)** as being unpatentable over **Timmons et al** (753), in view of **Chabreck et al.** (WO 98/28026) or **Kolluri et al** (5,723,219) or **Connell et al** (UK 1,037,144), as applied to claim 28-39 & 42-43 above, and further in view of **Tatsukami et al.** (4,166,079).

While all the above combinations suggest further functionalizing or reacting functional groups retained via plasma polymerization depositions, thus suggesting employing such processes with retained epoxy functional groups, as well as suggesting that such further reactions may be with amines, none of the above references suggest employing a solution of diethylamine in methanol for 24 hours to effect a 59% reaction of the epoxy groups on the polymer coating, however to **Tatsukami et al.** demonstrate that it is an old and well-known reaction to perform "aminating" of glycidyl acrylate copolymers using a

Art Unit: 1792

solvent mixture of amines & a lower alcohol, where lower alcohol may be methanol & the amines may be a secondary amines, such as dialkylamines like diethylamine (abstract; col. 2, lines 28-col. 3, line 26, esp. 4 & 12; & col. 4, lines 4-10). In col. 2, lines 59-68, Tatsukami et al. note that the aminating reaction may take a long time to complete with epoxy groups, thus teach means to shorten the process by optimization of solution, temperatures, etc., as long reaction times are considered not advantageous industrially. It would've been obvious to one of ordinary skill in the art to employ aminating procedures as taught by Tatsukami et al. on the plasma polymerized GMA resulting from the above combinations, given the teachings of the above combinations of references, such as Timmons et al.'s (col. 9-10) suggestion of plasma depositing polymers with intact functional groups (e.g. including epoxy) for further chemical derivations (e.g. including amine groups, as discussed above), especially with further consideration of Kolluri et al. explicitly suggesting the reaction of retained epoxide groups with secondary amines (e.g. table 1, #14) or Chabreck et al.'s examples C-14 or C-15 that react a glycidyl functionalized substrate with an amine solution, including alcohol based ones (both also discussed above); as the above combination of references show & suggest the desirability of aminating the resultant epoxide plasma polymers, with Kolluri et al. specifically suggesting dialkyl amines, while alternatively Chabreck et al. explicitly suggests using solution treatments for derivations. Tatsukami et al. clearly shows the reasonable expectation that a diethylamine methanol solution will effectively react with a plasma polymer derived from GMA, as it may be considered reasonably equivalent to the ethylene-glycidyl acrylate copolymers treated by Tatsukami et al., who thus provides reasonable instructions for optimizing the animation process, for both completeness of reaction & time required to perform it.

9.

Claim 40 is rejected under 35 U.S.C. **103(a)** as being unpatentable over **Timmons et al** (753), in view of **Kolluri et al** (5,723,219), as applied to claims and 28-39 & 42-43 above, and further in view of **Mitscher** (4,374,979) or **Hammar** (4,578,405).

Art Unit: 1792

While all the above combination suggests further functionalizing or reacting functional groups retained via plasma polymerization depositions, thus suggesting employing such processes with retained epoxy functional groups, as well as that further functionalization may be via vapor reactions, the references do not specifically suggest treating a epoxide functionalize surface with trifluoroacetic acid vapor for 30 minutes to react 89% of the epoxide groups in order to produce a reacted surfaces having unspecified functional group results (e.g. reacted, how doesn't matter). However, as noted above Kolluri et al. teach epoxy functional groups as one of a possible first group of functional groups to be deposited by plasma polymerization, generally teaching a second vapor deposition via plasma to attach second functional groups reacted to the first functional group, where the second functional groups includes carboxy, carboxylic ester, hydroxy, etc., where taught monomer sources for carboxylic acid functional groups include acetic acid (claims & col. 6, lines 31-40), however Kolluri et al. does not specify trifluoroacetic acid, nor specifically reacting epoxy & carboxylic acid groups.

While the above combination provides the specific suggestions of reacting epoxide groups from plasma polymerized GMA with various vapor phase amines, it also provides the more generalized suggestion to perform further vapor phase reactions that form other derivative, as the suggested process is not limited to the specific suggested examples, but providing a generally applicable technique. Epoxy groups are old and well-known to be reactive with trifluoroacetic acid (TFA) as shown by **Mitscher** (col. 5, lines 40-56; col. 8, lines 16-24 & col. 14, lines 50-60; employing TFA to open the epoxy ring to form keto groups) or **Hammar** (abstract; col. 5, lines 9-15; col. 9, lines 10-30, providing trifluoroacetic functionalization by reacting the epoxide group in glycidyl acrylate or glycidyl methacrylate), hence it would've been obvious to one of ordinary skill in the art, given known chemical reactions to employ TFA for further functionalizing the epoxide groups from plasma polymerized GMA from the above combination, to employ further vapor phase reactions as suggested by Kolluri et al., with the reasonable expectation of providing useful reacted surface, such as keto groups or further trifluoroacetic

Art Unit: 1792

functionalization, dependent on routine experimentation to determine effective reaction parameters (e.g. temperature, vapor pressure, reactant partial pressure, etc....) for producing particular results (note claims are lacking in requiring any specific results & the specification is lacking in means to effect any particular results).

10. **Other art of interest** includes **Timmons et al.** (2009/0240013 A1), which while not prior art, is relevant to the state-of-the-art; & **Miura et al.** (JP 62-80644 A), who provides further teachings on treating polymers having epoxy groups with fluoroacetic acid (abstract).

As stated in section 6 of the 9/28/2005 action, it remains noted that FR 2,581,991 to **Delfort et al** cited by PCT, continues to provide cumulative evidence that the amine groups provided to the active epoxy functional groups on the coated surface, would have been expected to proceed in a covalent coupling reaction or derivatization at the site of the epoxy as suggested and claimed, as well as providing further evidence of the known desirability of such reaction products.

As previously cited, **art of interest** included: **Kokaku et al.** (4,863,557: col. 3, lines 3-16 & col. 4, lines 4-22; & PN 4,560,641; col. 3, lines 39-68, esp. 63-67 & col. 6 Exs. 5 & 6), who teach GMA & AGE or glycidyl vinyl ether as used equivalently for plasma polymerization deposition; and **Taguchi et al.** (2003/0124382 A1), who in [0039] terms glycidyl acrylate, GMA & AGE, as all being classed as epoxy-containing vinyl monomers, thus all showing expectations of analogous chemistry &/or analogous plasma polymerization reactions. Note that Kokaku et al. (557), while not teaching the necessity of having remaining epoxy functionalities, nor pulsed plasma, does indicate that for their 13.56 MHz HF plasma at monomer pressures of 0.01-5 Torr, that appropriate ranges of plasma density (for area, not volume) include $0.01-10 \text{ W/cm}^2$, which is not quite the same parameter as claimed, noting inclusion of a third dimension would likely produce overlapping parameter ranges. Similarly, **Yokura et al.** (JP 01-171856) performs plasma polymerization, particularly of acrylic or methacrylic compounds having a glycidyl group, where the English abstract particularly exemplifies glycidyl methacrylate preformed at

Art Unit: 1792

pressure = 0.12 Torr & a power density discharge of 400 Wmin/m^2 (again based on area not volume), which is equivalent to 0.04 Wmin/cm^2 , thus it is noted that it is old and well-known in the art to employ relatively low power density is for plasma polymerization of GMA, even when there is no necessity in the teachings stating the desirability of maintaining the presence of the glycidyl (= epoxy groups) on the surface of the deposited layer, hence these references can be considered to provide evidence in support of or cumulative to the above discussed teachings of Timmons et al., as combined with the above rejections, as a person of ordinary skill in the art when employing the teachings of routine experimentation would have reasonably considered such known power densities as maximum starting points for routine experimentation for preserving epoxy groups on GMA, given teachings suggesting that retention of the epoxy groups require lower power. It would be a matter of competence for a person of ordinary skill to consider variation in plasma parameters of particular reagents based on known parameters for related plasma polymerizations in combination with Timmons teachings on how to preserve functional groups on plasma polymerized depositions.

Also, **Hitachi LTD**'s JP 58-66938, as indicated by its 2007 Derwent abstract was found to be of interest for plasma polymerization of materials intended to be far-UV sensitive, where the abstract specifically indicates glycidyl methacrylate as being a useful material therefore, but the abstract contains no information on whether or not pulsed plasmas were contemplated, nor whether or not the plasma polymerized deposit contains reactive epoxy groups.

11. As applicants again discuss the previously submitted declaration of 2/13/09, thus discussion thereof is repeated below.

The **Declaration of Dr. Stephen Coulson**, submitted 2/13/2009, was reviewed by the examiner. First, the examiner noted that the "0.0 95 W" on page 6 of the 8/13/08 of Office Action was supposed to be --9.5 W-- as indicated by Dr. Coulson in section 4 of his declaration. However, the comparison of approximate "average power" (declaration sections 5-6) from Timmons et al.'s exemplary parameters &

Art Unit: 1792

those of applicants, now enabled by knowing that applicants' chamber volume was 470 cm^3 (i.e. gives maximum possible size the plasma envelope or plasma volume, which would probably have been somewhat smaller than chamber volume), is not a particularly useful or meaningful comparison, since it is the average power **density** that we need to know for both processes to make a meaningful direct comparison of specific parameters, as different areas of surface being treated/plasma polymerized in a plasma will have that average power spread over different plasma volumes, thus achieving significantly **different** average power densities from the **same** average power (i.e. $9.5\text{W}/(470 \text{ cm}^3) = 0.0202\text{W}/\text{cm}^3$; or $9.5\text{W}/(1000 \text{ cm}^3) = 0.0095\text{W}/\text{cm}^3$; or $9.5\text{W}/(4000 \text{ cm}^3) = 0.0024\text{W}/\text{cm}^3$; or $9.5\text{W}/(8000 \text{ cm}^3) = 0.0012\text{W}/\text{cm}^3$; etc., noting that the 470 cm^3 volume is that disclosed by the Declaration & approximately $10 \times 10 \times 10 \text{ cm}^3$, or $20 \times 20 \times 10 \text{ cm}^3$, or $20 \times 20 \times 20 \text{ cm}^3$, or the like, are not unreasonable possible plasma volumes depending on the substrate surface being treated). Therefore, the Declaration's comparison of the approximate average power (0.04 W) derived from the example using peak power of 40W with on/off times on of $20\mu\text{s}/20\text{ms}$, "which is more than 200 times less than any average power referred to in Timmons [et al.]" (**section 6** of Declaration, presumably referring to the derived 9.5W), cannot be considered patently significant with respect to what effects are necessitated in the claim process versus the prior art, due to the claimed average power density of the pulsed plasma. This comparison especially cannot be considered significant if one considers that Timmons et al. exemplary parameter teachings are **not** intended to be generic to all possible pulsed plasma polymerizations, or even power parameters directed to retention of all possible functional groups generically, as they are suggesting the necessity of routine experimentation (col. 7, lines 15-58, etc.), as discussed in the rejections below. Also noting that the 200 W power & on/off time 3/60 was for plasma polymerization of the specific allyl bromide monomer (col. 6, lines 26-45; figures 6-7), with the teachings of Timmons et al. making it clear that one of ordinary skill would have been expected to apply routine experimentation for the specific monomer, specific functional group & particular apparatus configuration employed, dependent on desired functional

Art Unit: 1792

group retention. Furthermore, ~9.5 W is not the lowest average power that may be derived from Timmons et al., for example, when polymerizing C_9F_{18} the retention of $-CF_3$ content to produce hydrophobic surfaces using pulsed plasmas of 0.1ms/3.0ms on/off & 100 W peak power (abstract & figure 2C) gives ~3.2 W; or figure 8A discussed in example 5 (col. 16, line 45+), for pulsed plasma deposition using acryloyl chloride, 25 W peak power & on/off 10 μ s/1000 μ s gives ~0.25W average power, with figures 8A-8D & 9-10, clearly showing the expected trend of superior functional group retention (acid chloride group, $-COCl$), with decreased average power & duty cycle, where the very different average powers used for different monomers having different chemical functional groups to be retained, would clearly suggest to one of ordinary skill & competence in the art that each different chemical monomer would've been expected to be optimized individually. Also, since such a series of reactions would have had the whole series done in the same plasma apparatus, while average power is disclosed by Timmons et al., the trend suggested by these examples would have been applicable to average power density.

With respect to the experimental data supplied in **section 7** of the declaration, first it is noted that only two data points are generally not sufficient to definitively state that a trend is observed; second, given that the **claimed range** is of "average power density of the pulsed plasma discharge is less than 0.0025 W/cm³", which is inclusive of 0.0024999..., thus is insignificantly different than the 0.0025 W/cm³ data point provided by the Declaration, which is "just outside the claimed limit of average power density..." & would reasonably be expected to have an insignificantly different epoxide retention than the largest average power density values included in the claimed range, hence the examiner cannot conclude from the data that any unexpected trend is observed from these two data points, either within the claimed range or between the claimed range and higher average power density values that are excluded, since as can be seen from the prior art as exemplified by Timmons et al. (figures 2-3 or 8-9 or 12) that the **expected trend** is that for **decreased average power** (which considering a series of experiments are all

Art Unit: 1792

done in the same apparatus, would also be decreased average power density), as caused by decreased duty cycle in pulsed plasma polymerization (& comparison to continuous plasma), is clearly shown to be **increased functional group retention** for decreased average power [density], where the particular ranges of powers & duty cycles are seen to be different for different monomers & functional groups thereon, which would clearly suggest to one of ordinary skill, the expectation and need for individualized optimization for a specific monomer.

Given that it is old and well-known in the prior art that epoxies as a class, are some of the most reactive functional groups (for example see Chabreck et al. (WO), page 4, last paragraph), and given that one of ordinary skill in the chemical art would readily recognize that the reactivity of a particular epoxy functional group would be affected by the rest of the molecule (generic College chemistry), one of ordinary skill in the art would **not** have expected 2 different epoxy monomers to require the same pulsed plasma parameters for optimization of functional group retention, unless they would generally were known to have the same reactivity under like conditions. Considering the teachings as applied in various rejections (repeated below), the more reactive the functional group desired to be retained, the lower the average power density one would have expected to employ. As the objective in the below combinations of references is plasma polymerize their monomers, while retaining a specified functional group (i.e. in our discussions epoxy), one of ordinary skill in the art would also recognize that the plasma deposition would have needed to be tailored in order **not** to activate the epoxy, so as to minimize its participation in any polymerization reactions, thus one of ordinary skill in the art would have generally expected the more reactive to functional group, the lower the applied average energy density in order to achieve functional group retention (although other considerations could interfere with this generalization, such as plasma production of photons which could cause photoreactions at lower energies or the like, for some compounds). Thus, while the data of **section 7** of the **Declaration**, & Table 1 on specification's p. 12, show increased epoxy retention between continuous & pulsed plasma (the latter, for 3.56 Hz plasmas,

Art Unit: 1792

with other disclosed parameters), and between a higher and a lower average power density (**the former**, no other plasma condition disclosed, not even if the plasma is pulsed), it is the *expected trend* based on the prior art.

With respect to the particular low values of average power density claim for pulsed plasma by applicants of $<0.0025 \text{ W/cm}^3$, the expected trend is also the more reactive the functional group, the lower the average power or more properly to lower the average power density required to retain the reactive functional group, which would appear to be consistent with the different average energies employed by Timmons et al. in optimizing retention of -Br content (9.5W) versus -CF₃ group (3.2W) versus acid chloride group (0.25W), noting epoxy retention would have reasonably been generally expected to require lower energy than these explicit examples of Timmons et al., due to no reactivity of epoxy groups in general, with expected variation dependent on the individual variation of the reactivity of the epoxy group of the particular molecule. Applicants' Declaration has not provided data which differs from these expectations, for reasons as noted above. Further note that Timmons et al.'s example with a series of tests for C(O)Cl retention (figure 9), show a sudden change in the functional group retention, which would reasonably suggest to one of ordinary skill in the art to expect a similar effect/trend for other functional groups, but where optimized average power (e.g. optimized average power density in order to be applicable to other apparatus configurations) would reasonably have been expected to be different, dependent on particular molecule & functional group.

The **opinions** expressed in the declaration in sections 8-9 with respect to low average power, such as 9.5W discussed in Timmons et al., & whether determining presently claimed power density for retention of an unspecified quantity of epoxy groups when plasma depositing glycidyl methacrylate, given no other constraints on the plasma deposition process (i.e. any means of pulsed plasma generation, any pressure, any temperatures, etc.), except pulsed plasma with average power density of $<0.0025 \text{ W/cm}^3$, is not agreed with for reasons as discussed above.

Art Unit: 1792

Furthermore, as one of ordinary skill in the art would readily recognize that the power density is not the only parameter which will effect plasma reactions, and the examiner finds no evidence that the particular claimed range of average power densities will have exactly the same effect or effectiveness on the plasma polymerization of GMA, regardless of the type of pulsed plasma (microwave, 13.56 MHz, dual RF frequencies, etc.), regardless of pressures, regardless of substrate temperature, etc., therefore the examiner does not find the presented evidence of the declaration convincing of unexpected results, especially considering that while the claims now require the plasma polymerize coating to have epoxy groups, this is inclusive of any amount of epoxy groups from one epoxy molecule to theoretical possible number of epoxy groups, where the teachings of the applied rejections would clearly indicate the expectation of retention of epoxy groups in general, thus unexpected results do not appear to be indicated for the scope of the claimed process.

With respect to **section 11** in the Declaration, which discusses examples 4 and 5 (pages 16-19, figures 8 & 9) of the present specification discussing allyl glycidyl ether (AGE) & butadiene monoxide, these examples did **not** show **no** epoxy (peak present in spectra) retained when using pulsed plasma with conditions like that used for GMA, nor does the specification provide any reason why different molecules that happen to have epoxy functional groups would necessarily have been expected to have the same optimization, since the examiner would not expect the reactivity of these epoxy functional groups to necessarily be the same in each of these different monomers. Furthermore, while the declaration comments on the pulsed plasma AGE deposition having a substantial portion of the epoxy functionality lost & a very slow deposition rate, these issues are irrelevant to the claim as presented, since neither the amount of epoxy retained, nor the deposition rate are limited in the claims, thus may include processes with slower depositions & less retained epoxy in the cited Ex. 4, especially as the claimed process is NOT commensurate in scope with the examples of the specification using GMA.

Art Unit: 1792

Applicants' **opinion** expressed in **section 12** of the Declaration does not appear to be consistent with the meaning of **equivalents** with respect to **patent limitations**. Kolluri et al. teaches that either AGE or GMA may be used in plasma polymerization, where their reactive epoxy functional groups are used in subsequent reactions, which is clearly supportive of the expectation of being able to plasma polymerize either of these compounds, with **retention** of at least some epoxy groups. The comment concerning "significantly higher powers" used in Kolluri et al., fails to point out the disclosure to which they are referring, but is presumably the example 1 on col. 21-22, which has nothing to do with epoxies, either AGE or GMA, hence one of ordinary skill would not have expected acrylic acid monomer of the pulsed plasma deposition to have the same chemical reactivity as epoxides in general or GMA specifically. Furthermore, the total power applied is not the relevant parameter & as previously discussed (repeated in below rejection), an approximated average power density is **not** significantly higher but indicates probable close or overlapping values, thus these comments do not provide any convincing arguments.

The opinion of **section 13** of the Declaration, which appears to state that the invention (i.e. claims) "represent a significant scientific contribution" due to the lack of a specific operational example that provides a specific example using claimed parameters & using an epoxy (presumably as opposed to explicitly suggesting their use, but without specific plasma parameters), is not convincing of patentable significance for the claims as written, since in the applied patent documents having patentable significance is not necessarily the same standard as a scientific contribution for publication. It is not necessary for references to provide operational examples of all of their suggested options, such as suggested reagents like GMA or AGE, in order for a process to be considered taught or obvious to employ those reagents in the manner suggested. The applied prior art combinations clearly suggest the use of GMA in pulsed plasma depositions, clearly suggest routine experimentation & clearly suggest optimization for retention of functional groups, inclusive of epoxy, hence for reasons detailed above, the

Art Unit: 1792

examiner is not convinced that the claimed plasma polymerization of GMA using any pulsed plasma that has an average power density $<0.0025 \text{ W/cm}^3$ would require more than routine experimentation to determine such parameters when optimizing for desired deposit, thus does not find arguments for unexpected results convincing.

12. **Applicants' arguments** filed 11/11/2009 & partially discussed above, have been fully considered but they are not persuasive.

Applicants argue "it is surprising that low powers could lead to such high levels of reactive epoxy groups in the polymer coating" (first full paragraph of page 7 of 11/11/09 response), however applicant's claim no particular levels of epoxy groups in their polymer coatings in any of their claims, and given above discussed teachings of Timmons teach with respect to using lower powers to increase the number of reactive functional groups, thus the use of low powers is not surprising in producing larger amounts a functional groups, of whatever types, it is expected.

Applicants' arguments (page 11 of 11/11/09 response) with respect to the variable duty cycle disclosures in Timmons et al., are absolutely irrelevant with respect to the present claims as written, since nothing in applicants' claims prohibits employing an initially higher average powers when depositing on a substrate, as long as sometime during the pulsed plasma deposition of the claimed glycidyl methacrylate, but claimed average power densities less than 0.025 W/cm^3 is employed & retains functional epoxy groups, as a substrate on which previous plasma polymerization has occurred, is still a substrate; or a single ON/OFF sequence having a progressive variation of duty cycles, is still a sequence or this arbitrary designation could also be applied to all pulsed plasma deposition at a single duty cycle, nor are the teachings of Timmons et al. as discussed in col. 12 necessarily limited to their teachings of employing a gradation of duty cycles in order to effect better adhesion with the initial deposit & increased retention of desired functional groups at the surface with decreased duty cycle.

Art Unit: 1792

Applicants' CLAIMS only require that the coating produced contains some epoxy groups, how little or how many is unlimited, thus any arguments with respect to amounts epoxy functional groups are totally irrelevant to applicants claims as written. The claimed average power density does not necessitate any particular concentration of claimed epoxy groups in the claims as written, especially not considering all the new matter applicants have presented in their new claims, which are not commensurate scope with examples in the specification, hence no results that might be inferred for those examples with respect to epoxy functionalization amounts are relevant to the claims as written.

Applicants assert that remarkable adhesive properties are shown by their example 3. While example 3 merely discusses generically that "two glycidyl methacrylate plasma polymer coated strips of polymer film (polyethylene, PE ICI, 0.80 mm thick, or polytetrafluoroethylene, PTFE, Goodfellow, 0.25 mm thick)", were treated in this example, it does for further figures 5 & 6, which if you backtrack, indicates on page 10 that the pulsed plasma employed 20 μ s on, 20 μ s off, with peak power of 40 W for an undisclosed amount of time, thus this example while providing deposition examples on different substrates in example 1, does not broaden the data with respect to the pulsed plasma in the specification, which does not specify what average plasma density it was used for the examples therein, as example 3 uses the same parameters but lacks information with respect overall time. Two data points present in section 7 of the 2/13/2009 declaration encompassing the claimed endpoint & 1 other point, as previously discussed, are insufficient to provide significance to all average power densities of pulsed plasmas in the claimed range, since there is not even any information with respect to any other parameters, hence how plasma pressure, a monomer flow rate, treating already deposited monomers, etc. (e.g. all the various undefined parameters encompassed in the scope of applicants claims), will affect retention of the claimed epoxy groups (e.g. two data points do not a trend prove, especially with insufficient context). Thus we are simply left with whether employing lower powers, or more properly lower average power densities (since comparing absolute power values is relatively lacking in meaning), would have reasonably been

Art Unit: 1792

expected to enable retention of functional groups, specifically epoxy functional groups -- this concept is well established in the art, as seen in above discussion. The specification & declaration lack clear showing that the claimed average power density is significant with respect to all possible pulsed plasma parameters it may be employed with when using glycidyl methacrylate **in the scope claimed**.

While applicants' claims & arguments appear to not recognize that other plasma parameters will affect the relevance of any single parameter to the overall results, especially power, this concept is well recognized by those ordinary skill in the art & specifically discussed by Timmons et al. who states "... as anyone who is well-versed in the practice of plasma polymerization will recognize, the correlation between applied electromagnetic power in the plasma generated film composition is complicated by the fact that many other process variables must be simultaneously considered. These additional variables include such factors as the size (e.g. volume) of the reactor, the location of the substrate relative to the plasma discharge zone, the monomer flow rates, the monomer pressure, the nature of the monomer, etc. For example, it is well known that increased monomer functional group retention can be maintained at a given power by increasing the monomer flow rate... Likewise, the use of a large reaction volume at a given applied power would also provide increased retention of monomer functional groups, as this variation in effect decreases the power density during the plasma polymerization process..." col. 7, lines 25-58. Given the paucity of information concerning no important plasma parameter variables provided by applicants' claims, specification (esp. relevant to scope claimed) & the 2/13/09 declaration, it is impossible to conclude that choosing one known plasma polymerization monomer + the claimed average power density in absence of all other critical parameters, provides a results which is necessarily unexpected for all claimed power densities under all conditions, or even that it is unexpected for any, as one would, given teachings as discussed above, generally expect pulsed power, especially at lower pulsed power densities to provide a greater retention of reactive functional groups, especially if one does not even need to be concerned about any other characteristic of the coating, such as adhesion, etc.

Art Unit: 1792

13. **Any inquiry** concerning this communication or earlier communications from the examiner should be directed to **Marianne L. Padgett** whose telephone number is **(571) 272-1425**. The examiner can normally be reached on M-F from about 9:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Marianne L. Padgett/
Primary Examiner, Art Unit 1792

MLP/dictation software

12/12/2009

12/13/2009